PUA
PLC Utilities Alliance

GRUPO EDP **IBERDROLA** **E endesa** **Enel** **EEF FEW** **EnBW Die Energie-AG.** **EDF Electricité de France** **UNION FENOSA**

Powerline an alternative technology in the local loop

- Presentation to IEEE -

March, 2004

Agenda

1	**PLC Utilities Alliance**
2	Power Line Communications
3	Access PLC competitive solutions
4	Endesa's PLC project

PUA — PLC Utilities Alliance

The "PLC Utilities Alliance" (PUA) is an organization supporting Power Line Communications (PLC) development in Europe

Members

PUA — PLC Utilities Alliance

Members

endesa, EDF Electricité de France, EEF FEW, GRUPO EDP, EnBW Die Energie-AG., IBERDROLA, Enel, UNION FENOSA

More than 100 Million electrical customers in 23 countries

Objectives

- Develop a **common position** among PUA members
- Work with **national and EU bodies** to obtain a favourable environment for PLC development
- **Raise Awareness** about the PLC opportunity
- **Technical reference point**
- Help **standardisation** process
- Support PLC equipment **Research and Development**

Achievements

Awareness & Promotion

- **White Paper** on PLC and its Impact on the Development of Broadband in Europe
- **Communication** with EU bodies, NAs, and other stakeholders

Standardization & Regulation

- **Measurement campaign in five European countries**
- **Work in different standardisation bodies**
  - ETSI, CENELEC, CISPR, JWG

International Cooperation

UPLC UNITED POWER LINE COUNCIL, plcforum

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In 2004, the Awareness and Promotion Task Force of the PUA will have a special focus to boost the PLC market and to obtain a progress in key markets and utilities

2003 tasks follow-up

- ■ **Maintain relationship with European Commission and National Authorities**

- ■ Consolidate as industry reference point

- ■ **Keep collaborating with standardization and regulatory organizations**

New developments for 2004

- ■ **Focus on utilities (help in the commercial launch processes)**

- ■ Focus on relevant stakeholders (operators, media, financial market)

- ■ Increase and structure exchange of information between PUA members

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Agenda

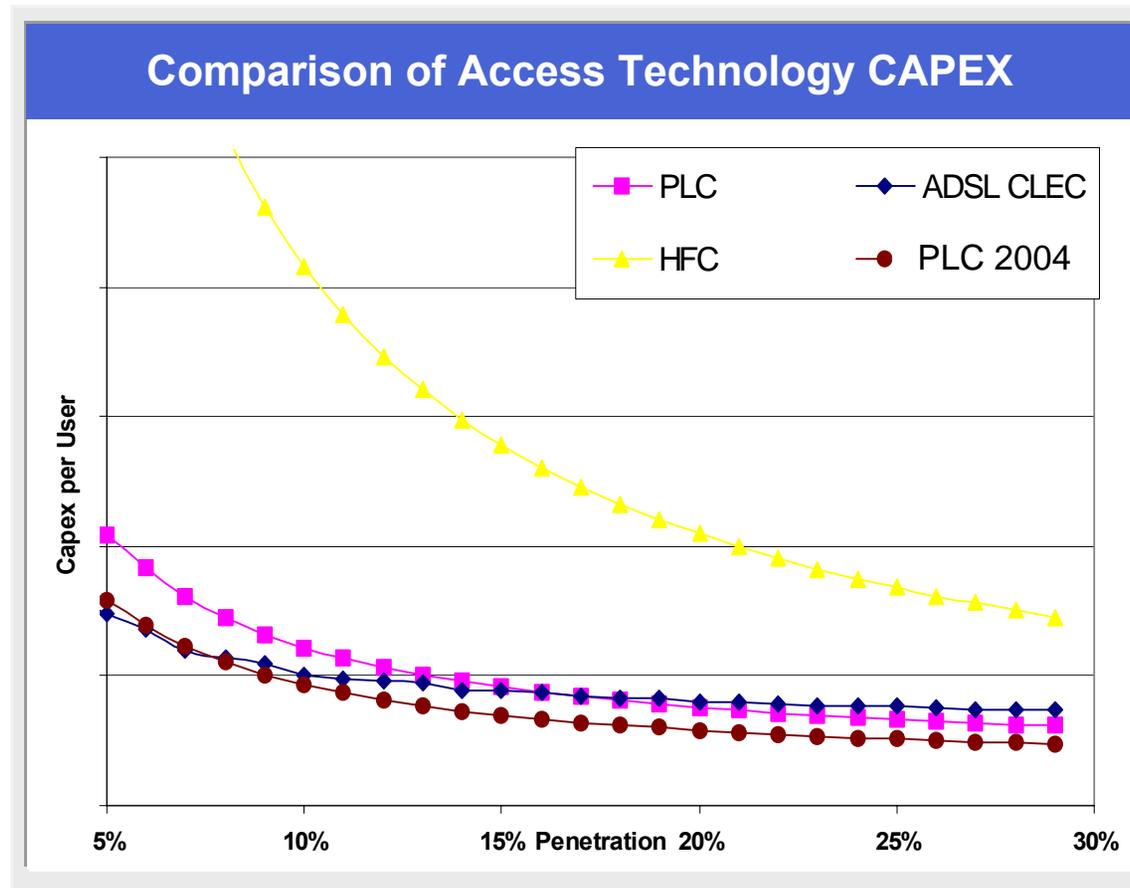| 1	PLC Utilities Alliance
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As an access technology, PLC is well positioned to compete with other access technologies in the mass market

	HFC	*ADSL*	*PLC*
Infrastructure	• Fiber+Coaxial cable and copper pair [1] (New deployment)	• Copper pair (existing telephone lines)	• Electric wires (existing power grid)
Shared Medium	Yes (Tipically 1000 users[2])	No (Dedicated line per user)	Yes (Approx. 200 – 250 users)
Services	• Triple play: TV+Telephony+Broadband	• Broadband - Pre-launching: TV, VoD - Testing: Telephony (VoDSL)	• Broadband • Telephony (VoPLC) - Testing: VoD, energy services, PLC in-home services
Data transmission rate	• 45 Mbps(down)/10Mbps (up) • Commercial offers usually up to 2 Mbps	• 4 - 6 Mbps (ADSL) • Typically Asymmetric	• **45 Mbps (up + down)** • **New generation: 200 Mbps** • **Symmetric**
CAPEX per client[3]	HIGH	MID-LOW	**MID-LOW**

1 Copper wire necessary for voice service in non-integrated HFC networks
2 Strongly dependant on network design
3 Details subject to NDA

- ## PLC technology is able to compete with ADSL in the residential segment

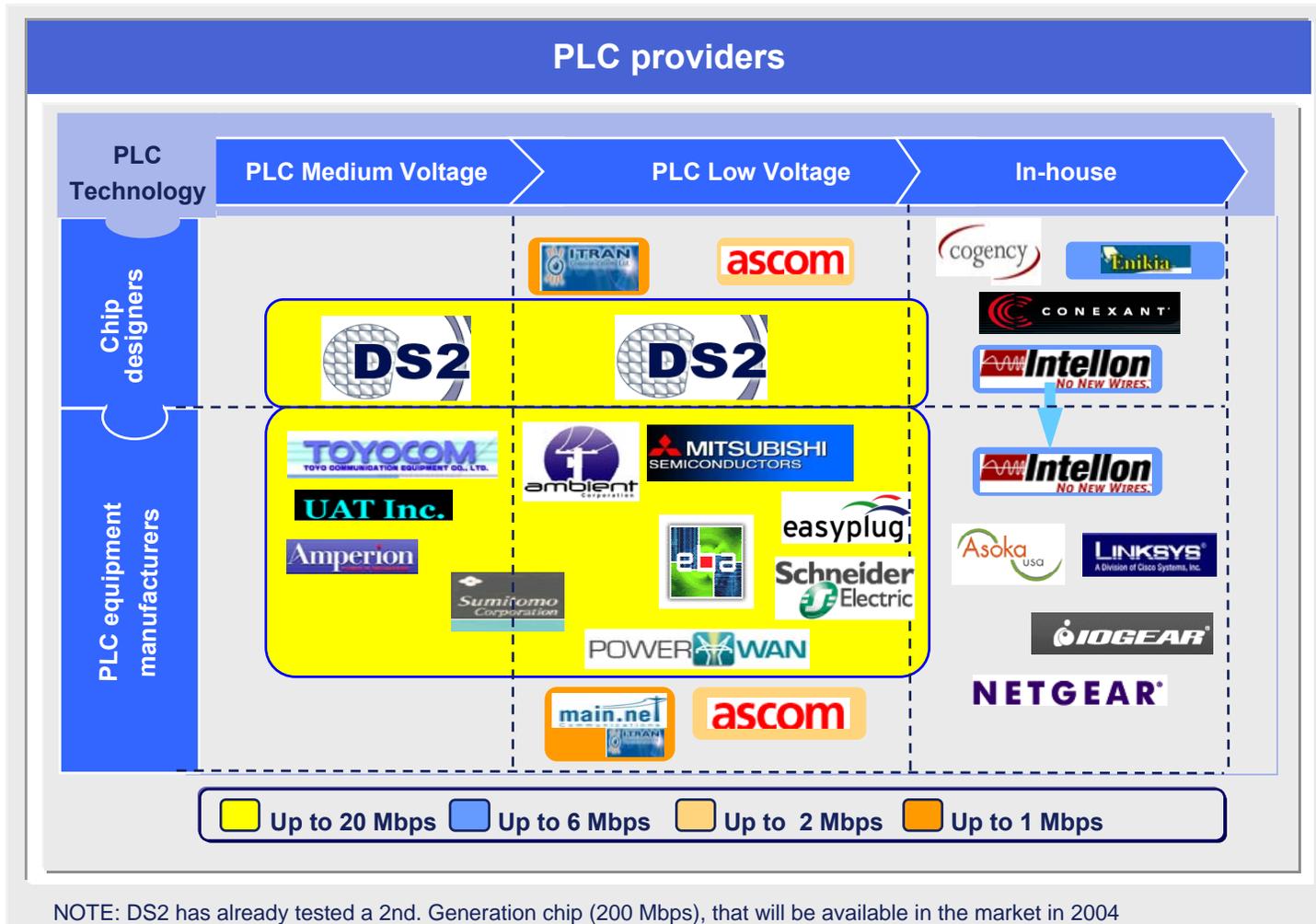### Comparison of Access Technology CAPEX

Powerline Communications – PLC as alternative access infrastructure

In terms of roll out and provisioning, PLC is very well positioned to compete with other access technologies in the mass market
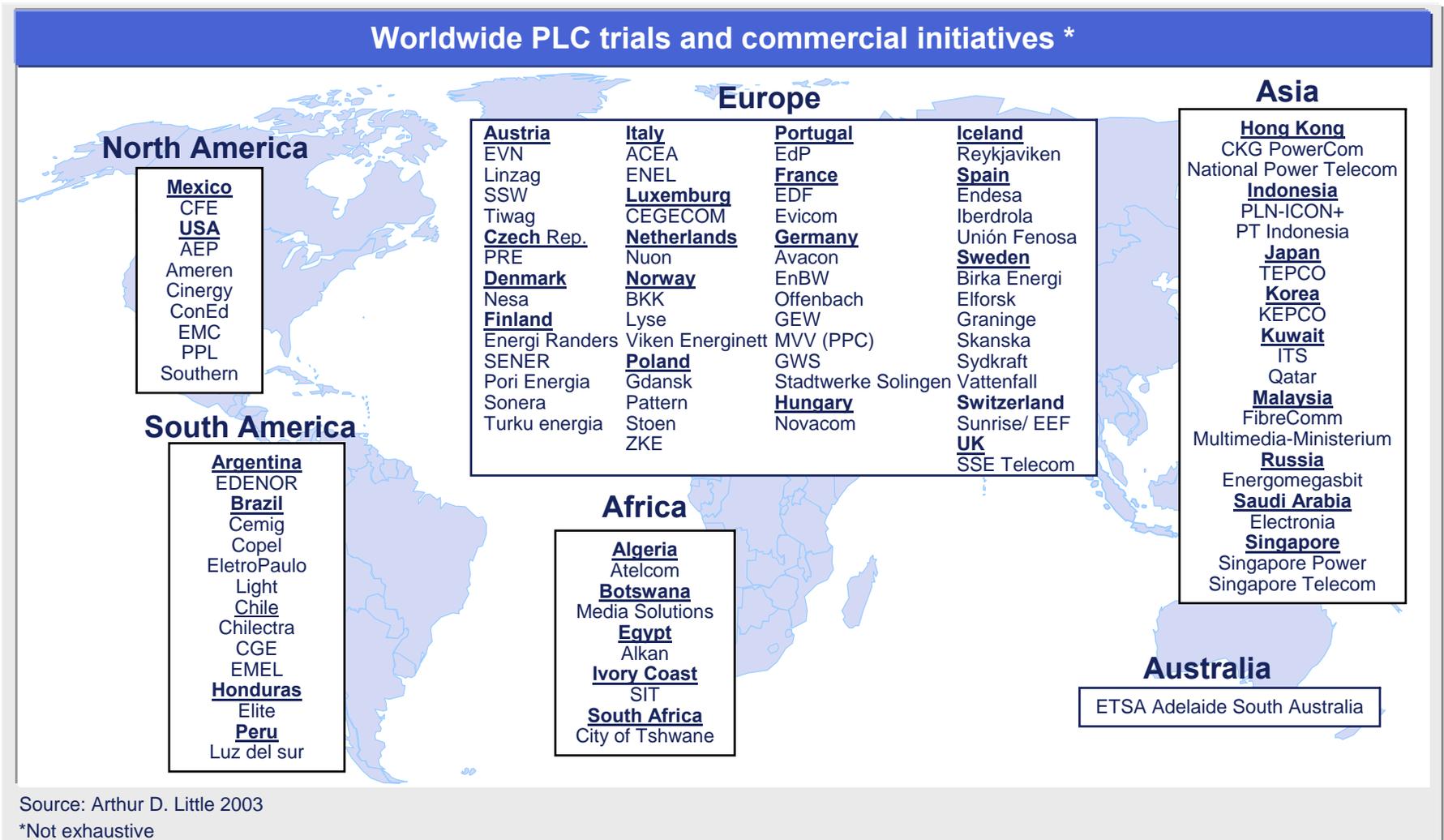
	HFC	ADSL	PLC
Roll-out	• Requires lengthy construction of new network • Civil works require public permissions (street digging, buildings) • Once an area is chosen for deployment, roll-out is not selective	• Possibility of rapid deployment, but CLECs are **highly dependent on incumbent** • In practice, deployment is being challenged by a slow ULL process • Requires availability of collocation space in incumbent´s Central Offices and logistics	• **Rapid deployment** over existing electric infraestructure (LV + MV substations, property of the utility and easily conditioned for PLC) • **Selectivity** at substation and meter room level • **Minimum need of civil works** (linking of LV substations through MV PLC)
Provisioning	• Reasonable provisioning process time • Requires installation from the street curb to client house of coax drop • Requires installation of CPE at the client´s household • For blocks of flats / apartments wiring permission from neighbors is required	• Short to medium provisioning process time for ILEC, longer delays for CLECs (shortening) • Service availability varies from region to region (from as low as 50% to 95%) • Auto-installation DSL reduces provisioning time for basic services • CLEC **dependency on incumbent** to test and approve line	• **Short provisioning time** (just a CPE in user's domicile) • No permissions required • No works at customers premises (high acceptance) • **Ubiquity**: Any conventional electrical plug becomes part of the telecommunication network

Powerline Communications – Manufacturers

Leading manufacturers ensure the availability and development of PLC equipment. 2nd generation chipset will increase performance and competitiveness


NOTE: DS2 has already tested a 2nd. Generation chip (200 Mbps), that will be available in the market in 2004

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More than 80 PLC initiatives in more than 40 countries show a high interest in PLC technology among worldwide utilities

Worldwide PLC trials and commercial initiatives *

Europe

Austria	**Italy**	**Portugal**	**Iceland**
EVN	ACEA	EdP	Reykjaviken
Linzag	ENEL	**France**	**Spain**
SSW	**Luxemburg**	EDF	Endesa
Tiwag	CEGECOM	Evicom	Iberdrola
Czech Rep.	**Netherlands**	**Germany**	Unión Fenosa
PRE	Nuon	Avacon	**Sweden**
Denmark	**Norway**	EnBW	Birka Energi
Nesa	BKK	Offenbach	Elforsk
Finland	Lyse	GEW	Graninge
Energi Randers	Viken Energinett	MVV (PPC)	Skanska
SENER	**Poland**	GWS	Sydkraft
Pori Energia	Gdansk	Stadtwerke Solingen	Vattenfall
Sonera	Pattern	**Hungary**	**Switzerland**
Turku energia	Stoen	Novacom	Sunrise/ EEF
	ZKE		**UK**
			SSE Telecom

North America

Mexico
CFE
USA
AEP
Ameren
Cinergy
ConEd
EMC
PPL
Southern

South America

Argentina
EDENOR
Brazil
Cemig
Copel
EletroPaulo
Light
Chile
Chilectra
CGE
EMEL
Honduras
Elite
Peru
Luz del sur

Africa

Algeria
Atelcom
Botswana
Media Solutions
Egypt
Alkan
Ivory Coast
SIT
South Africa
City of Tshwane

Asia

Hong Kong
CKG PowerCom
National Power Telecom
Indonesia
PLN-ICON+
PT Indonesia
Japan
TEPCO
Korea
KEPCO
Kuwait
ITS
Qatar
Malaysia
FibreComm
Multimedia-Ministerium
Russia
Energomegasbit
Saudi Arabia
Electronia
Singapore
Singapore Power
Singapore Telecom

Australia

ETSA Adelaide South Australia

Source: Arthur D. Little 2003
*Not exhaustive

Many companies already started controlled commercial initiatives, and some of them have already launched PLC services

PLC initiatives development status*

Technology trials	Massive (>100 users) technology trials	Pre-commercial and commercial initiatives
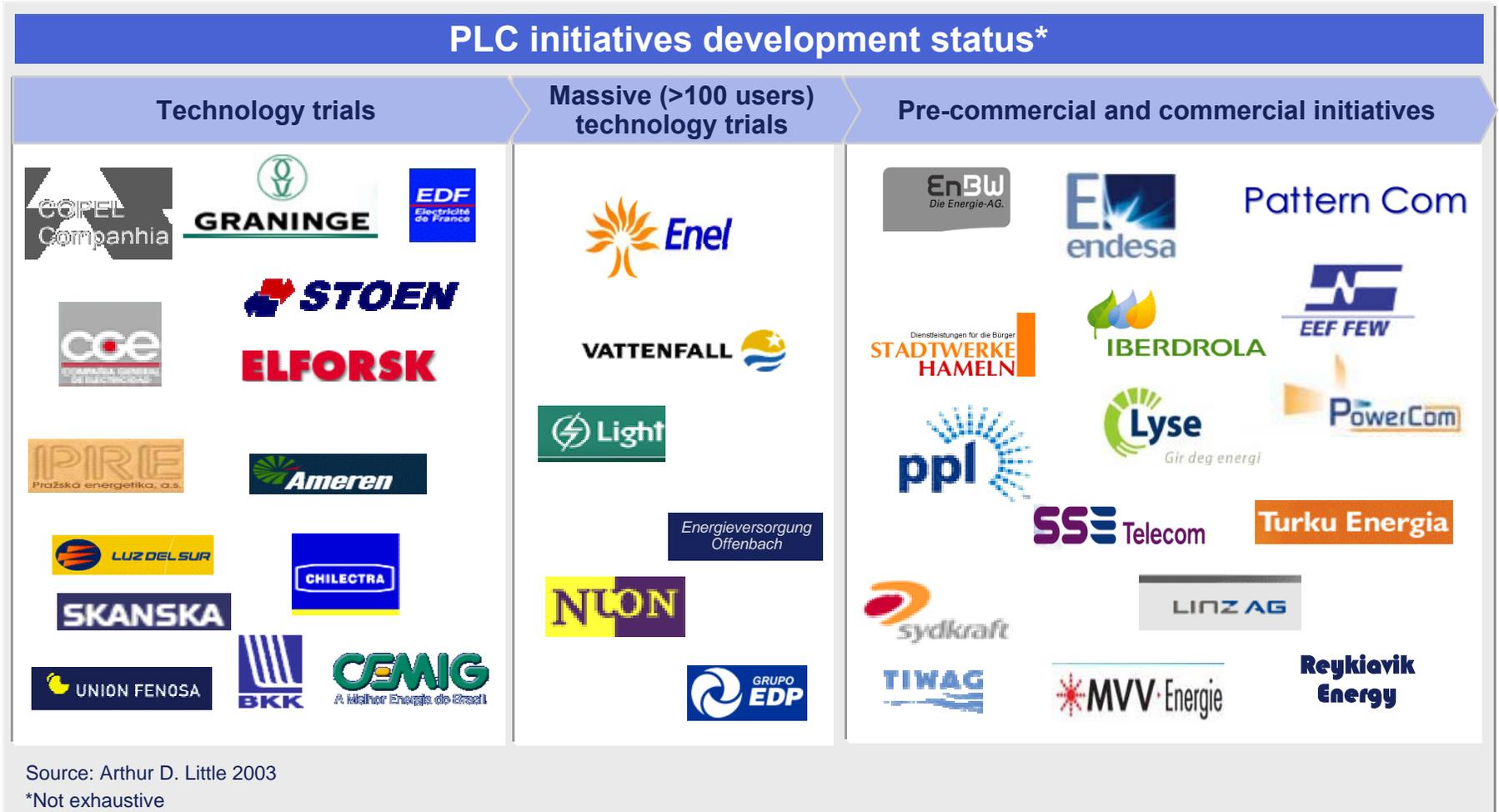
Source: Arthur D. Little 2003

*Not exhaustive

Agenda

1	PLC Utilities Alliance
2	Power Line Communications
3	**Access PLC competitive solutions**
4	Endesa's PLC project

Source: Arthur D. Little Global Broadband Report, 2003
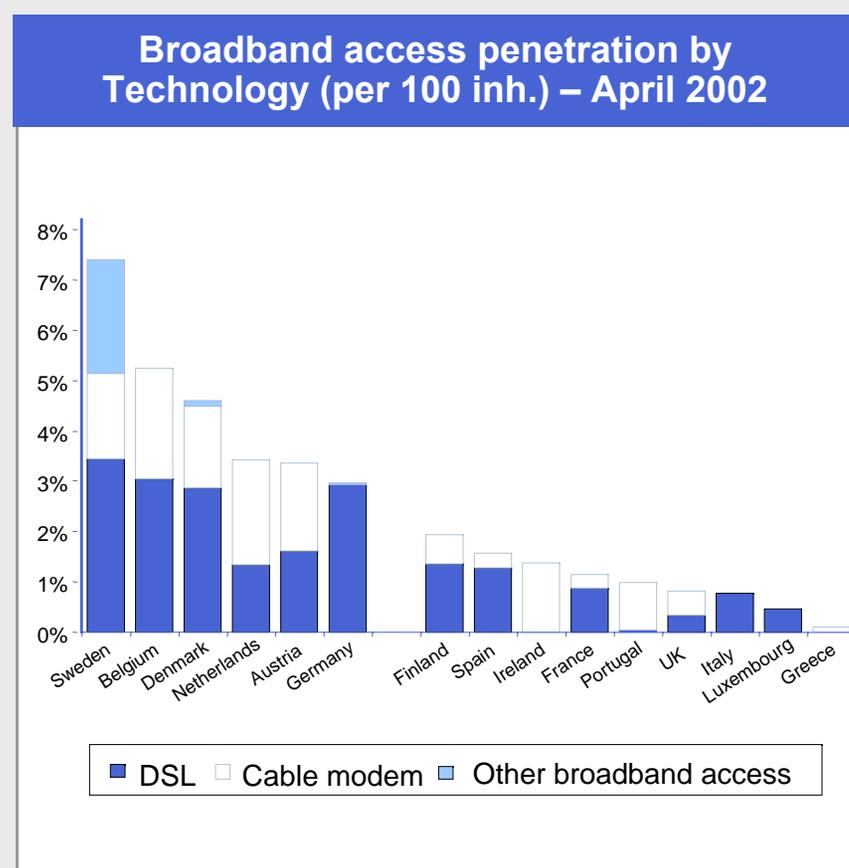
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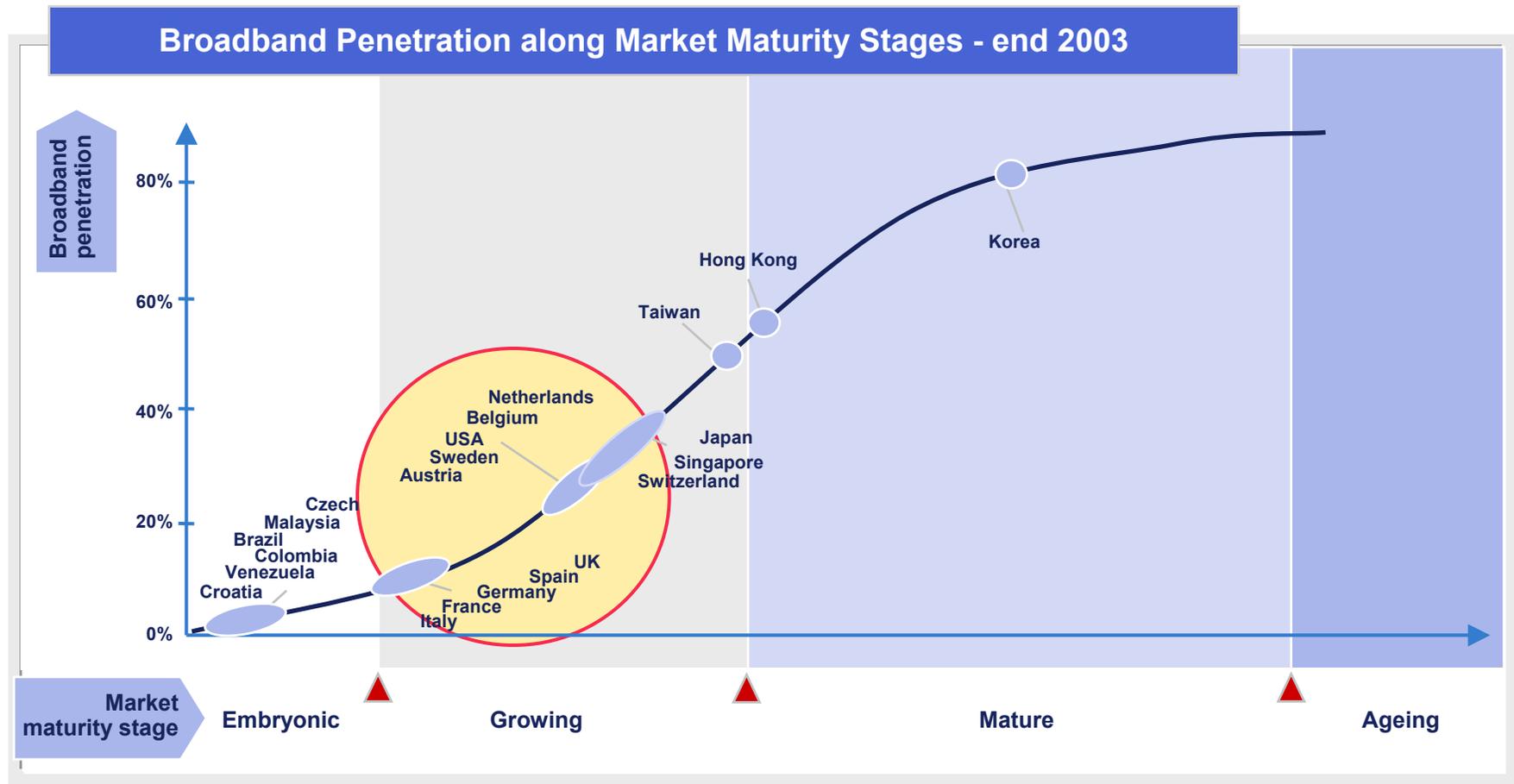
Significant increases in Broadband <u>penetration</u> <u>are forecasted</u> for the next years, with many European and USA markets <u>approaching 50% by 2008</u>
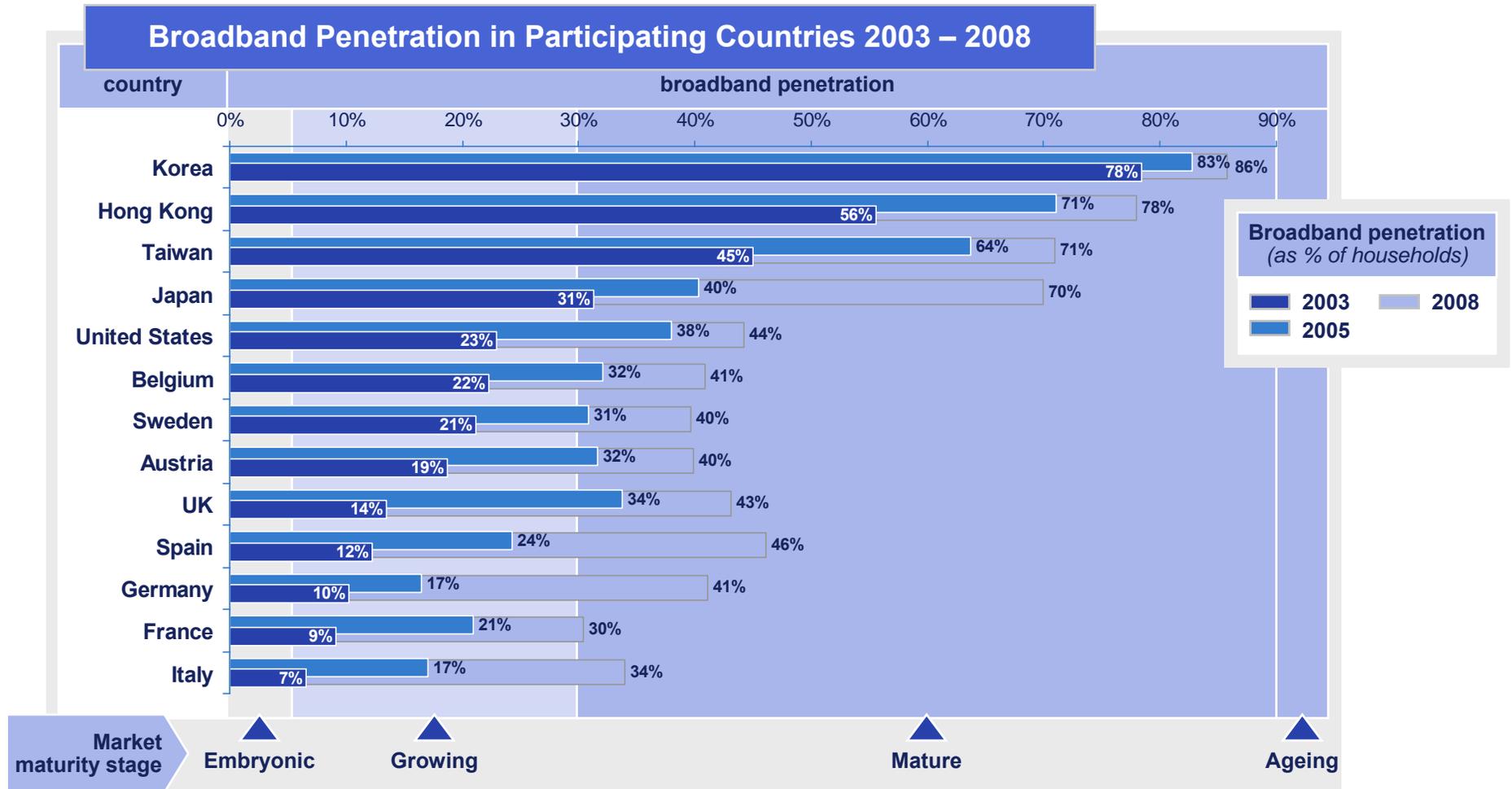
Broadband Penetration in Participating Countries 2003 – 2008

Source: Arthur D. Little Global Broadband Report, 2003

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There are many EU member states <u>without</u> alternative <u>access infrastructure</u> and the investments in new fixed access infrastructure have been delayed or cancelled

Broadband access penetration by Technology (per 100 inh.) – April 2002

DSL ▪ Cable modem ▪ Other broadband access

Infrastructure competition vs. Broadband penetration increase – 2002-2003

Broadband penetration percentual points increase 2002-2003

High level of infrastructure competition
High penetration growth

Lower level of infrastr. competition
Lower level of penetration growth

Difference in market share of two dominant access technologies (in %) – end 2002

Sources: ECTA 2002, OECD 2001, "White Paper on Powerline Communications and its Impact on the Development of Broadband in Europe, 2002" (Developed by Arthur D. Little for the PLC Utilities Alliance), DG Information Society, October 2003, Arthur D. Little Global Broadband Study, October 2003
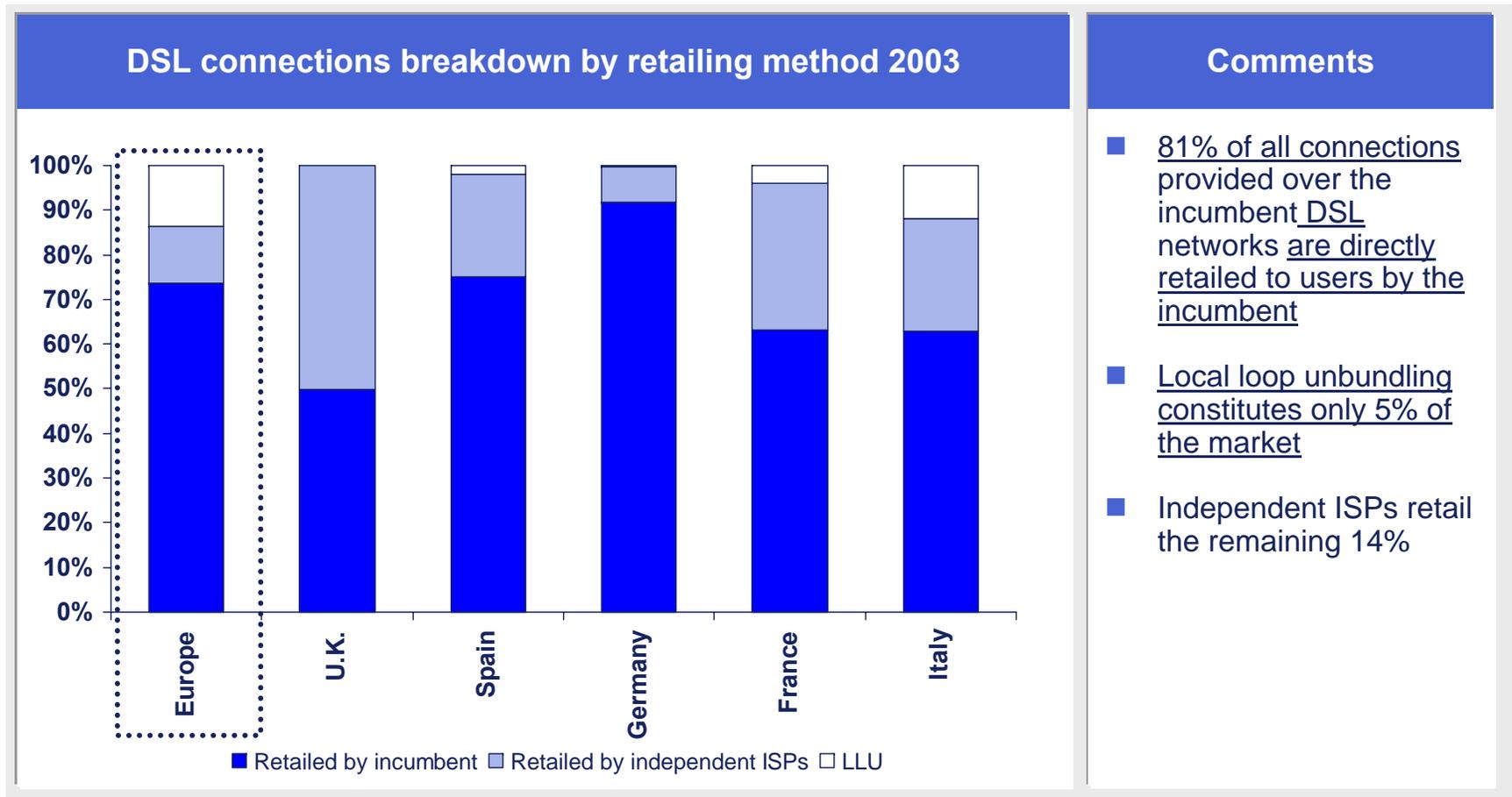
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Digital subscriber line (xDSL), using copper telephone lines, currently is the prevalent technology for delivering Broadband access in most European markets
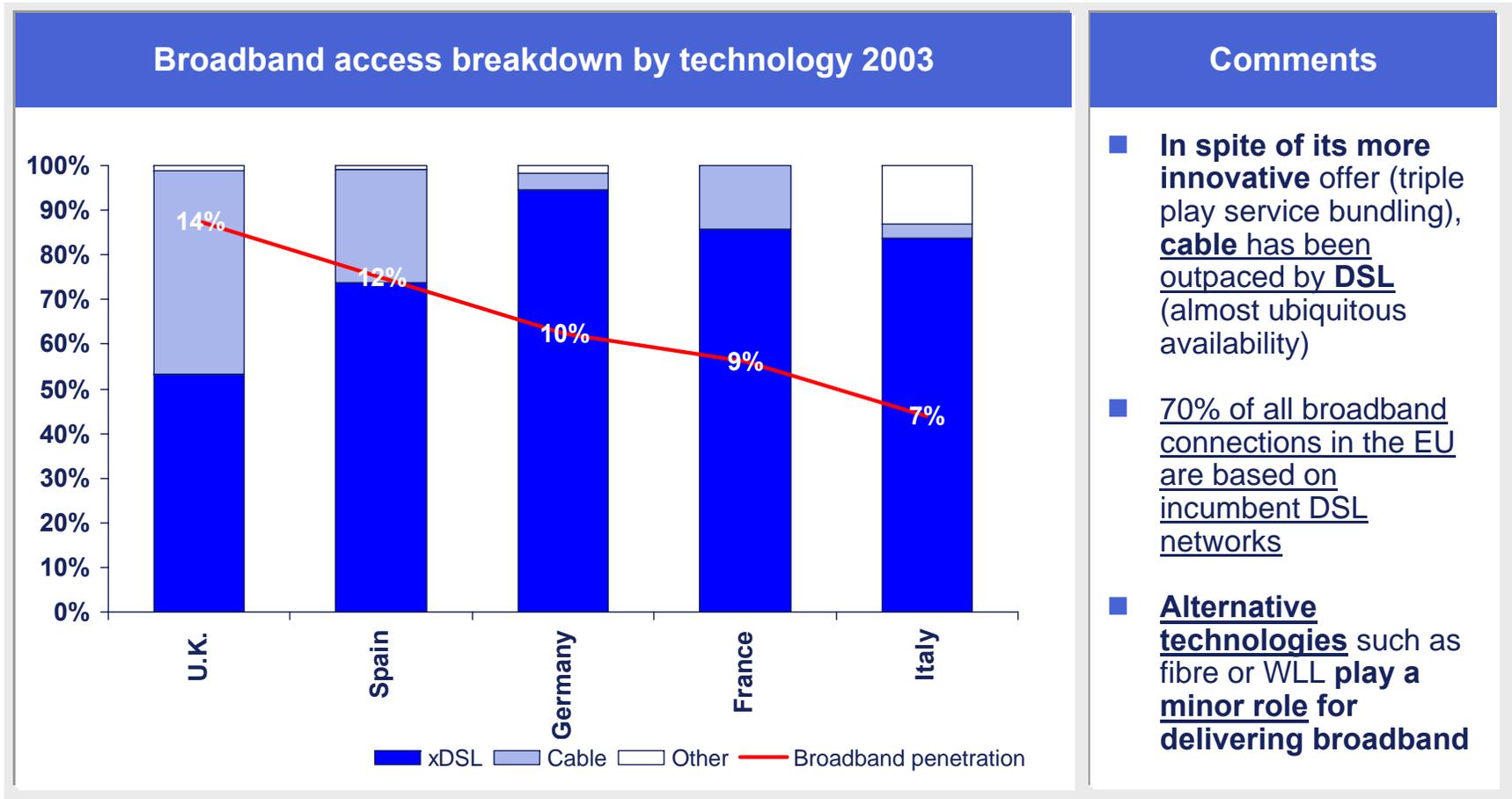
Broadband access breakdown by technology 2003	Comments

- **In spite of its more innovative** offer (triple play service bundling), **cable** has been outpaced by **DSL** (almost ubiquitous availability)

- 70% of all broadband connections in the EU are based on incumbent DSL networks

- **Alternative technologies** such as fibre or WLL **play a minor role for delivering broadband**

Legend: xDSL | Cable | Other | Broadband penetration

Data labels: 14%, 12%, 10%, 9%, 7%

Countries: U.K., Spain, Germany, France, Italy

Incumbents dominate not only the physical provision of DSL broadband, but also the retail market

DSL connections breakdown by retailing method 2003

Legend: ■ Retailed by incumbent ■ Retailed by independent ISPs □ LLU

Countries: Europe, U.K., Spain, Germany, France, Italy

Comments

- **81% of all connections provided over the incumbent DSL networks are directly retailed to users by the incumbent**

- **Local loop unbundling constitutes only 5% of the market**

- Independent ISPs retail the remaining 14%

Source:DG ITU World Telecommunication Regulatory Database, ECTA, September 2003

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PLC is being launched and represents a great opportunity for utilities and telecom operators
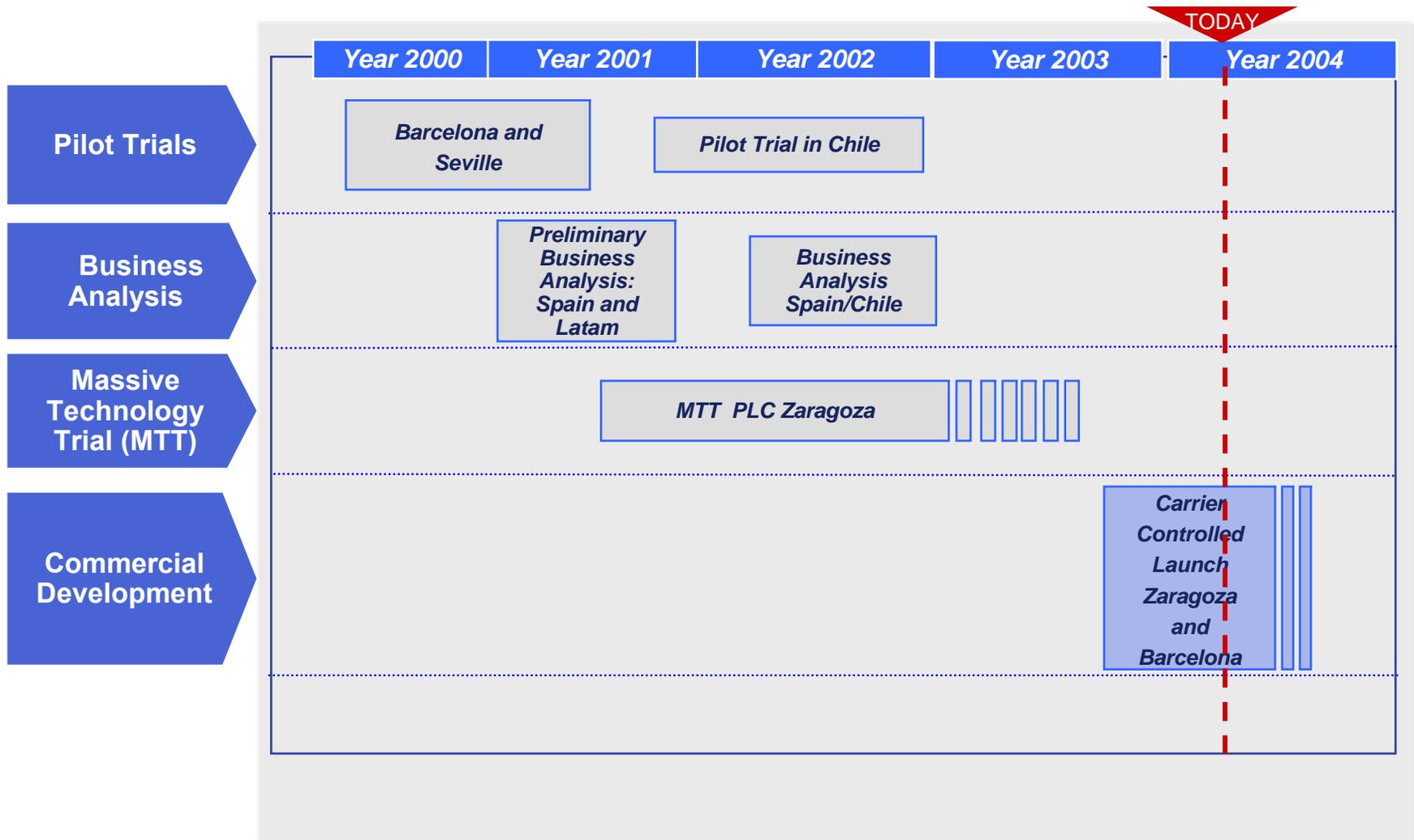
Conclusions

- Broadband is growing at a high rate and there is a **great market opportunity**

- Development of new access infrastructures is expensive and **the unbundling process has enjoyed only limited success**

- PLC is confirming itself as the access technology that could **compete with ADSL** in the residential and SOHO segment

- PLC is **commercially available**:

  - ➢ High coverage and ubiquity of the electrical network

  - ➢ Broadband Internet (symmetric transmission) and VoIP services

  - ➢ Fast modular and selective deployment

  - ➢ In-house installation fast and simple

  - ➢ First tier manufacturers are commercializing products

- Utilities are solid partners and PLC business is within their **core competences**

- The **wholesale carrier access business** model could be **appropriate** for utilities and telecom operators
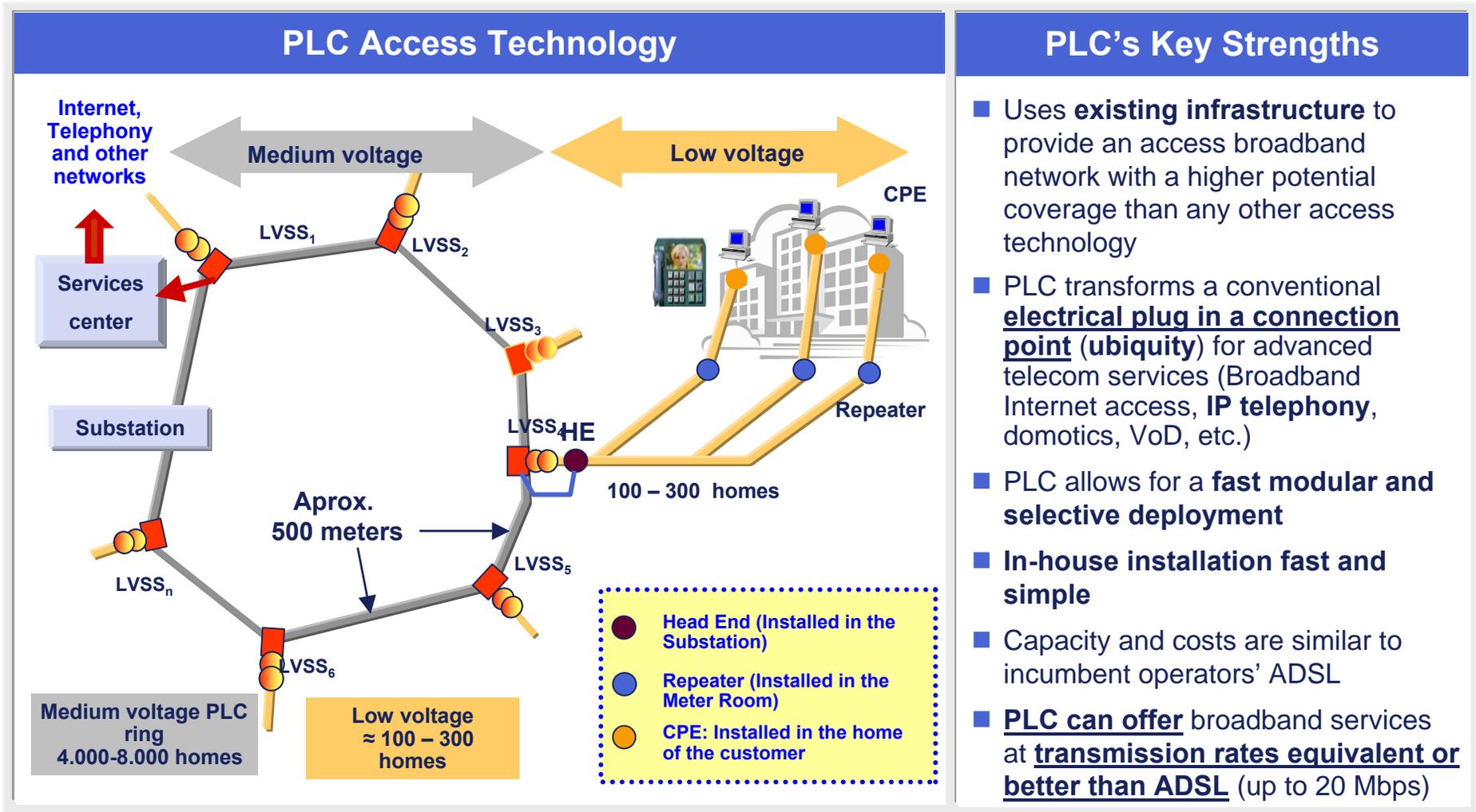
1	PLC Utilities Alliance
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3	Access PLC competitive solutions
4	**Endesa's PLC project**

Endesa's PLC Project

After more than three years developing the PLC project, Endesa is now ready to undertake massive commercial deployments
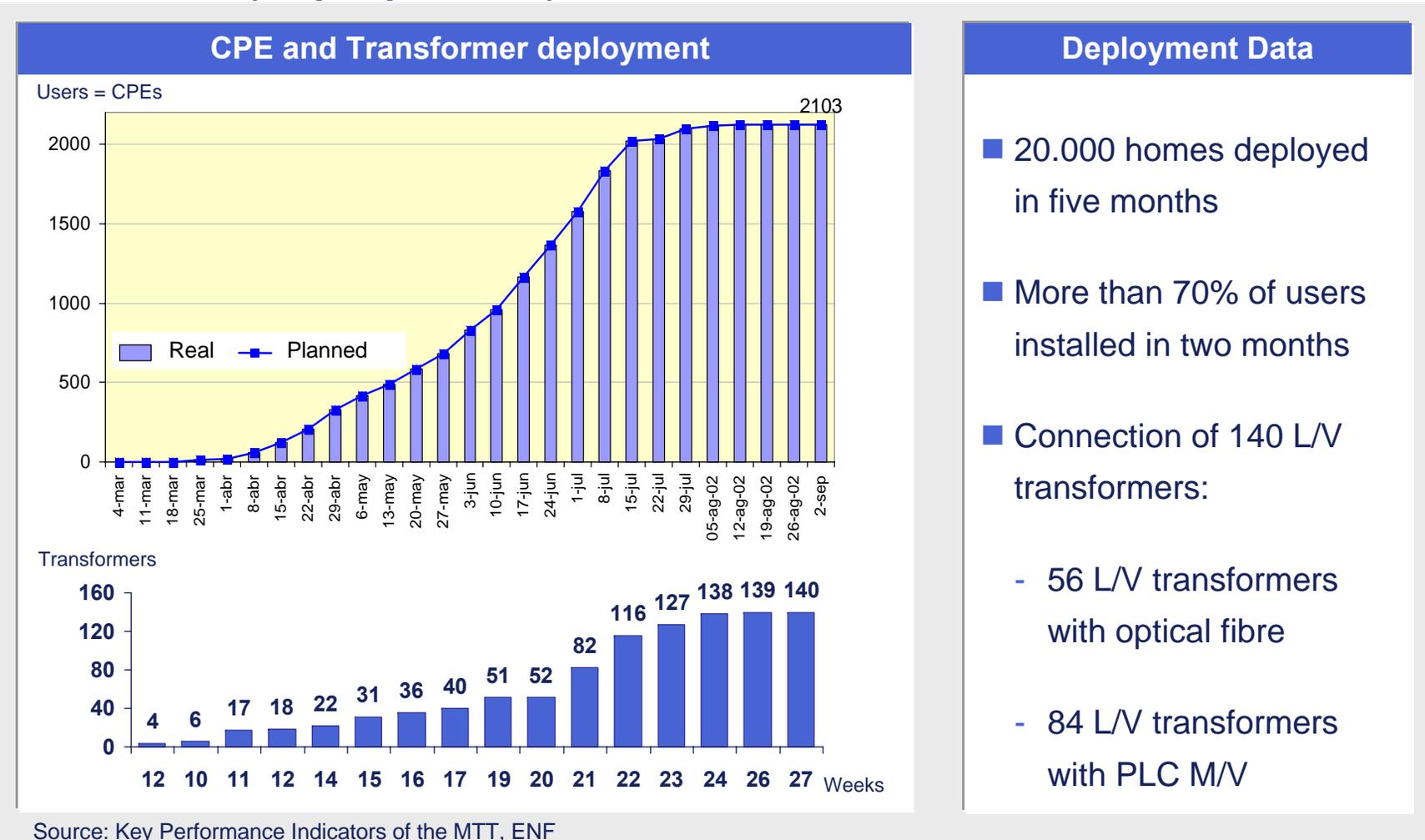
TODAY

	Year 2000	Year 2001	Year 2002	Year 2003	Year 2004

Pilot Trials

Barcelona and Seville

Pilot Trial in Chile

Business Analysis

Preliminary Business Analysis: Spain and Latam

Business Analysis Spain/Chile

Massive Technology Trial (MTT)

MTT PLC Zaragoza

Commercial Development

Carrier Controlled Launch Zaragoza and Barcelona

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PLC is a broadband technology using low and medium voltage power lines for digital transmission of voice and data

PLC Access Technology
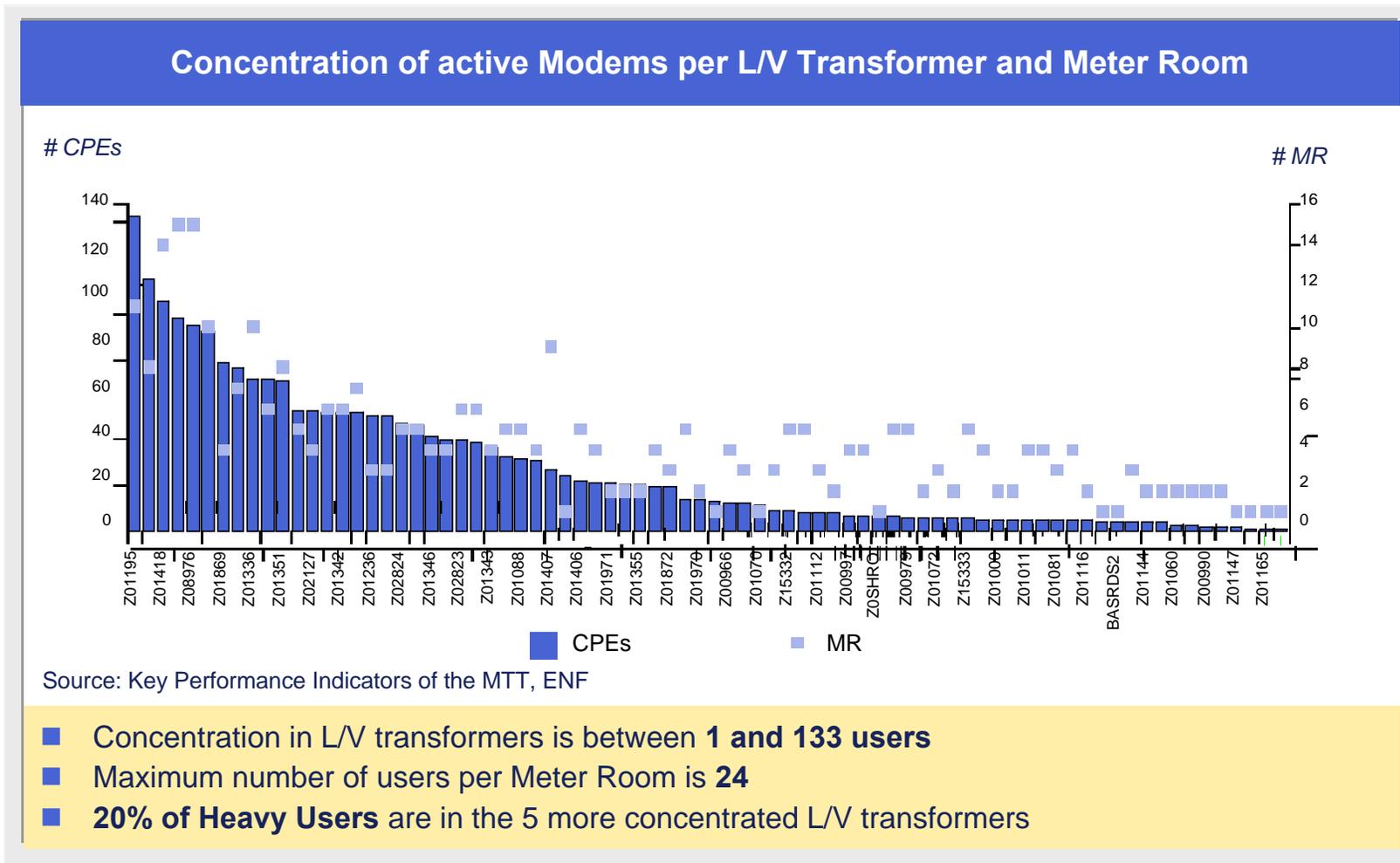

Internet, Telephony and other networks

Medium voltage

Low voltage

Services center

Substation

LVSS$_1$

LVSS$_2$

LVSS$_3$

LVSS HE

LVSS$_5$

LVSS$_6$

LVSS$_n$

CPE

Repeater

100 – 300 homes

Aprox. 500 meters

Medium voltage PLC ring 4.000-8.000 homes

Low voltage ≈ 100 – 300 homes

● Head End (Installed in the Substation)

● Repeater (Installed in the Meter Room)

● CPE: Installed in the home of the customer

PLC's Key Strengths

- Uses **existing infrastructure** to provide an access broadband network with a higher potential coverage than any other access technology

- PLC transforms a conventional **electrical plug in a connection point** (**ubiquity**) for advanced telecom services (Broadband Internet access, **IP telephony**, domotics, VoD, etc.)

- PLC allows for a **fast modular and selective deployment**

- **In-house installation fast and simple**

- Capacity and costs are similar to incumbent operators' ADSL

- **PLC can offer** broadband services at **transmission rates equivalent or better than ADSL** (up to 20 Mbps)

During the MTT in Zaragoza, 330 buildings, 140 low voltage transformers, 20.000 homes and 2.103 users where deployed and placed in service in only five months (25 people team)

CPE and Transformer deployment

Deployment Data

- 20.000 homes deployed in five months

- More than 70% of users installed in two months

- Connection of 140 L/V transformers:

  - 56 L/V transformers with optical fibre

  - 84 L/V transformers with PLC M/V

Source: Key Performance Indicators of the MTT, ENF

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Different concentration levels per L/V transformers and Meter Rooms were tested and it was proven that there are no significant impacts on the QoS due to high concentration levels

Concentration of active Modems per L/V Transformer and Meter Room

 # CPEs

 # MR

■ CPEs   ■ MR

Source: Key Performance Indicators of the MTT, ENF

- Concentration in L/V transformers is between **1 and 133 users**
- Maximum number of users per Meter Room is **24**
- **20% of Heavy Users** are in the 5 more concentrated L/V transformers

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Internet users showed an intense and symmetric usage of PLC services during the Massive Trial

INTERNET ACCESS: Daily total traffic (MB)	Comments

MB/day

— Ip In MBytes
— Ip Out MBytes
— MB total

Date

Sep 02   Oct 03

INTERNET ACCESS: Users' distribution per average daily usage

Num of Users

48%
631

11%
142

17%
217

5%
64

7%
96

3%
39

10%
126

De 0 a 5   De 6 a 10   De 11 a 50   De 51 a 100   De 101 a 500   De 501 a 1000   > 1000

% Users

"Heavy Users"

Daily traffic Total MB (In + Out)

○ **Daily traffic average per user: 200 MB**

"Heavy Users"
20% of the users with highest traffic during the Trial

- 87% of users use the Internet service daily

- 94% of users use it weekly

- The Spanish average Internet usage is 5,3[*] MB daily

- 20% of users manage more than 100 MB daily (Heavy users)

Source: Key Performance Indicators of the MTT, ENF

(*) Source: NetValue, Internet Overview, Junio 2002

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Telephony usage pattern was above the Spanish average during the MTT

TELEPHONY: Daily traffic (Inbound & Outbound)

Calls

First stage   Second stage   Third stage

△ Call In
◆ Call Out Total

Máx.daily:
6.352 calls

○ **More than 1,5 millon calls**

Sep 02   Oct 03

TELEPHONY: Users' distribution per average daily usage

66% of users

19%		
17%		
13%		
10%		
7%	6%	6%
	4%	3%
3%		12%

220 192 149 121 85 69 67 47 32 34 142

Number of users

% users

Nº Calls per Day

1 2 3 4 5 6 7 8 9 10 More than 10

Source: Key Performance Indicators of the MTT, ENF

Comments

Stages

- First stage: Only local calls for all telephony users
- Second stage: Opening up of national calls communicated to a group of 500 users
- Third stage: Opening up of national calls communicated to a group of 500 users

Usage

- 65 % of the clients use the service daily and 84 % weekly
- 5,27 Calls per day and user
- In Spain the average number of calls per day of the residential segment is 4,2

Customer satisfaction measurements that revealed a high acceptance level of the global service offering and users' interest in continuing to use PLC services

Satisfaction with PLC services	■ The users have shown **very satisfied** with the **service quality of PLC Internet Access** ✓ *PLC has been evaluated better than ADSL (4,32 PLC vs. 3,65 ADSL)* ■ The users have shown **satisfied** with the service **quality of PLC telephony** ✓ *The general satisfaction with PLC telephony was 3,65 compared with 3,99 obtained by incumbent Telefónica*
Analysis of the general satisfaction of the trial and the disposition to continue	■ Very unsatisfied ■ Unsatisfied □ Indifferent ■ Satisfied □ Very Satisfied General Satisfaction: 4,22 0 1 2 3 4 5 ■ 85% of the users explicitly allowed Endesa to share their contact data with AUNA, in order to receive detailed information on the commercial terms of the PLC service
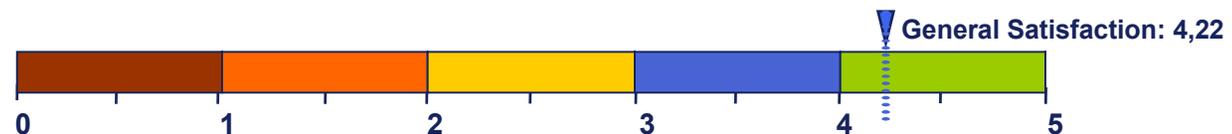
Source: User Satisfaction Study, Endesa Net Factory, November 2002

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The Massive Technology Trial has confirmed that PLC is a suitable technology for offering Broadband Access to the massive residential market

MTT conclusions
■ PLC can be applied to both low and medium voltage power grid
■ Network solution adopted can be used for any kind of electrical topology
■ Interconnection with Public Internet and Telephone Networks has proven viable
■ PLC related works over electric infrastructure do not affect electric service
■ **PLC network can be deployed quickly and selectively**
■ A high degree of standardization can be achieved for transformations centres and meter-rooms.
■ Technical coverage ratios are higher than those achieved by ADSL
■ **PLC can offer Broadband Internet Access (> 2 Mbps) and VoIP services**
■ Leading manufacturers ensure PLC equipment commercial availability
■ No complaints about electromagnetic interferences have been registered (Spanish Authorities have developed a specific measurement campaign)

The first Commercial Trial was launched in Zaragoza in October 2003, providing the customers with Telephony and Internet Access services through PLC

Characteristics of the Commercial Trial

- A specific *License* was obtained by Endesa, in order to conduct the Carrier Services (October 2003)
- Telecom Operator: *Auna TLC*
- Date of launch: *27th October 2003*
- Dimension: Up to *5.000 households* covered in *Zaragoza*
- Potential market:
  - existing deployment
  - new market in the same areas
- *Services* provided with PLC:
  - Telephony: Voice over PLC (VoPLC)
  - High speed Internet access: **128, 300 or 600 kbps** (up to 45 Mbps)
- The *Commercial Offer* was designed combining the services and different bandwiths, with competitive prices regarding those of ADSL in Spain
- Endesa has reached a *penetration of around 19%* in the PLC areas in Zaragoza

Description of the Commercial Offer

During the last months Endesa realized the rollout of PLC in two areas of Barcelona and just started its commercialization

Characteristics of the Commercial Trial

- Telecom Operator: *Auna TLC*
- Date of launch: *February 2004*
- Dimension: *5.000 households* covered in *Grácia and Sarriá Sant-Gervasi, Barcelona*
- *Services* provided with PLC:
  - Telephony: Voice over PLC (VoPLC)
  - High speed Internet access: **128, 300 or 600 kbps** (up to 45 Mbps)
- *Network Deployment*
  - 90 Transformer Stations in 9 rings
  - More than 90% of transformer stations are connected via Medium Voltage PLC

## Description of the Commercial Offer

The majority of the users of the Massive Technological Trial accepted to be contacted by the Telecom Operator and finally become "PLC customers"

The Commercial Trial in Figures	Penetration vs. Services

- A network covering 20.000 homes was deployed in only 5 months (25 people team)
- Provision time similar or better to ADSL
- Heavy use of voice services (>1,5M calls in 10 months)
- Internet users make an intensive use of PLC services:
  - 20% users>100MB and 10% users>1 GB of daily traffic
- High QoS (good service even for 80% penetration in one building)
  - The users have shown very satisfied with the service quality of PLC Internet Access
  - The users have shown satisfied with the service quality of PLC telephony
- **PLC 128, 300 and 600 kbps**
- **60% of the MTT users** signed a contract to be provided with the PLC services and started paying for them
- More than **25% of users are new customers**, who had not enjoyed the PLC services for free during the MTT
- 2 months after the commercial launch over **20% user penetration** was reached in the area covered

Number of contracts vs. Services

1%
29%
70%

- Internet
- Internet +Voice
- Voice
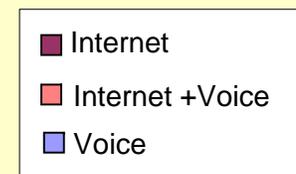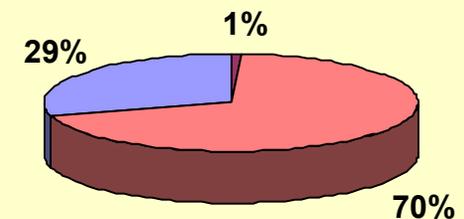
For all queries regarding the PLC Utilities Alliance and PLC opportunity please contact :

Marcos López
PLC Utilities Alliance President

ENDESA
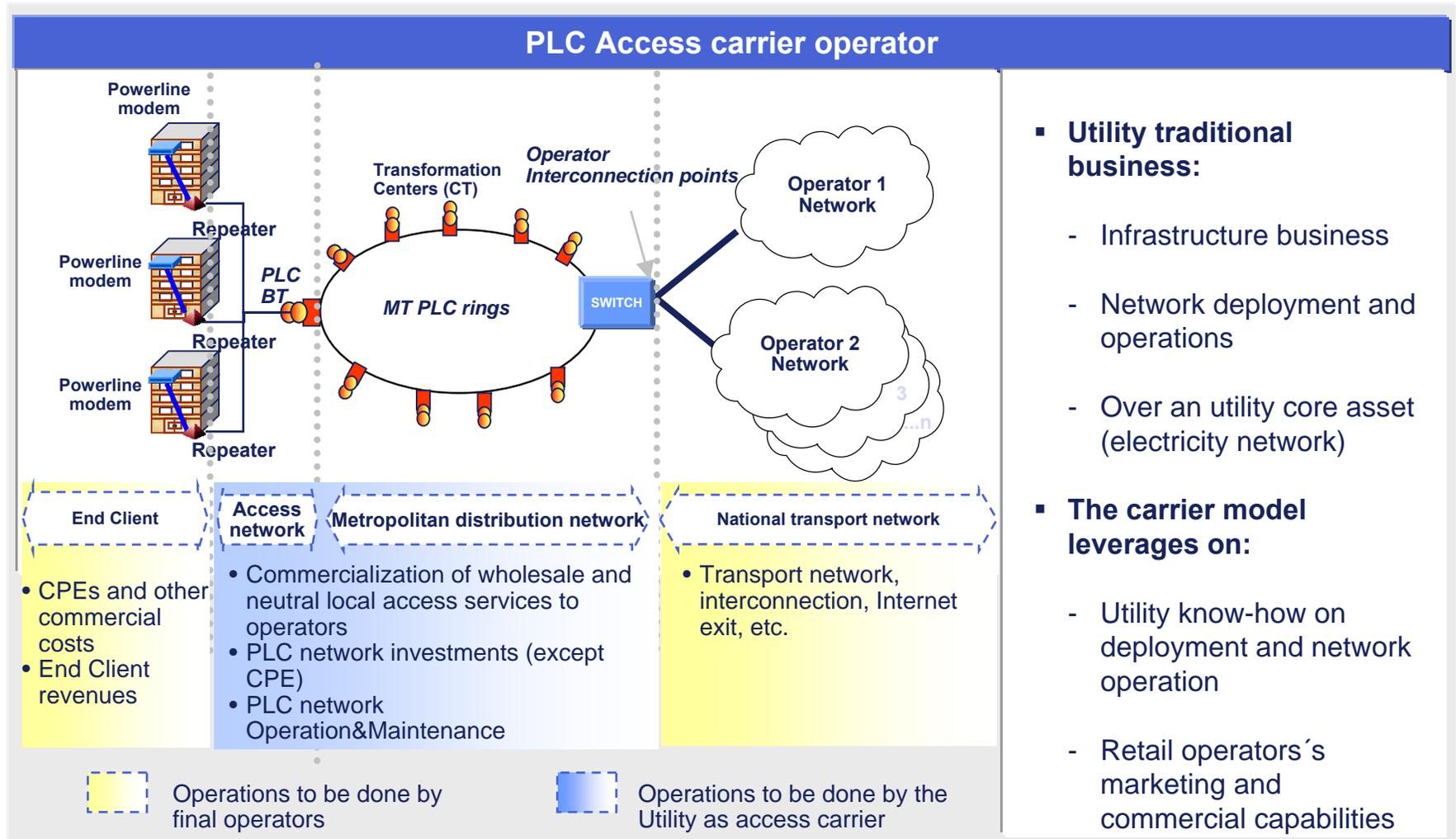**Ribera del Loira, 60, 3ª pl.**
28042 Madrid,Spain

Telephone: +34 91 213 10 12

Telefax: +34 91 213 48 06

Mail: mlopez@endesa.es

The majority of the utilities have selected an Access Carrier business model to develop its PLC opportunity

PLC Access carrier operator

- Powerline modem
- Repeater
- Powerline modem
- PLC BT
- Repeater
- Powerline modem
- Repeater

- Transformation Centers (CT)
- *Operator Interconnection points*
- *MT PLC rings*
- SWITCH
- Operator 1 Network
- Operator 2 Network
- 3 ...n

End Client
- CPEs and other commercial costs
- End Client revenues

Access network / **Metropolitan distribution network**
- Commercialization of wholesale and neutral local access services to operators
- PLC network investments (except CPE)
- PLC network Operation&Maintenance

National transport network
- Transport network, interconnection, Internet exit, etc.

Operations to be done by final operators

Operations to be done by the Utility as access carrier

- **Utility traditional business:**
  - Infrastructure business
  - Network deployment and operations
  - Over an utility core asset (electricity network)

- **The carrier model leverages on:**
  - Utility know-how on deployment and network operation
  - Retail operators´s marketing and commercial capabilities

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